# STATION DESCRIPTION
# MANCOS RIVER AT ANITAS FLAT, CO - 371508108212801
# MESA VERDE NATIONAL PARK

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|---|---|
| Prepared by: J.S. Grover | December 4, 2001 |
| Revised by: J.S. Grover | May 15, 2002 |
| Revised by: J.S. Grover | October 21, 2002 |
| Revised by: K.M. Converse | June 16, 2004 |
| Revised by: G. Gerber | September 9, 2008 |

## LOCATION:

The National Park Service's Water Resource Division – Water Rights Branch (NPS-WRB) gage on the Mancos River within Mesa Verde National Park (MEVE) is located at N 37° 15' 08", W 108° 21' 28" (HUC: 14080107), in Montezuma County, Colorado. The gage is located approximately 7.4 miles SSW of Mancos, CO, approximately 3.0 miles south of the confluence with Mud Creek on the right bank about 1.05 miles inside the MEVE boundary.

ACCESS:
To access the gage site take County Road 38 south off of State Highway 160 (the County Road 38 intersection is approximately 3 miles west of the town of Mancos and approximately 3.5 miles east of the turn off to MEVE). County Road 38 is paved for the first 3.5 miles. The last two miles are a private road, do not proceed without permission. A high clearance vehicle is recommended due to condition of unpaved road. The last quarter mile must be maneuvered with a small 4WD vehicle or walked due to road blockage. See **Figure 1** for a Gage Site Location Map.

A potential location for high flow measurements is a private bridge located approximately two miles north of the gage site (**Photo 1**). This private drive turns east just before the pavement ends. Permission to use the private bridge for high flow measurements has been granted by land owner's Vance and Naria Koppenhaffer. Owners request that vehicles be parked off of the road which is also the residence driveway.

NOTIFICATION:
Prior to gage site visitation the land owner's sons must be contacted by park personnel.
Land Owner: Charlie Mitchell

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|---|---|---|---|
| Contacts: | Son | Blake Mitchell | (970) 533-7253 |
| | Son-in-law | Paul Crook | (970) 533-7829 |

**ESTABLISHED:** The gage was initially established on July 18, 2000 by NPS WRB and park personnel.

**ELEVATION:** 6330 feet above MSL, as determined by GPS.

**DRAINAGE AREA:** The gage station has a drainage area of 160 $mi^2$ (based on GIS analysis of 1:100,000 USGS DLG data).

## HYDROLOGIC CONDITIONS:

Mesa Verde means "green table" describing the National Park as a high flat sloping plain covered with vegetation. The Mancos River, which provides the main drainage of Mesa Verde, cuts the main, deep valley along the mesa's eastern and southern edge. Valley slopes are moderate ranging from about 0.2 to 2.0%. More than twenty canyons cut through the Mesa and drain into the Mancos River. The Mancos River and tributaries cut through the Cliff House Sandstone and Menefee Geologic formations. The Cliff House Sandstone is composed of deposited beach sands and shallow water sands. Deposited woody shales, coals, and coarse irregular sands comprise the sediments of the lower Menefee Formation. Percolation of water through the sandstone until it reached an impervious layer in the Menefee Formation guided the water to the canyon edges. This water movement can be seen in seeps and springs as well as through the creation of the cliff dwellings' niches. The underlying Point Lookout Sandstone,

Menefee Formation, and Cliff House Sandstone create the Mesa Verde Group. The Mesa Verde Group overlies two older formations. The younger Mancos Formation is 2,000 feet of dark gray shale, while the Dakota Sandstone is a beach sand underlying most of Colorado. (Skridulis, 2004).

Mesa Verde National Park generally has mild weather during the summer months, and during some winters. Snow storms may occur as late as May and as early as October, but usually both of these months are pleasant. Summer days (June through September) are generally warm to hot, with cool evenings. Afternoon thunder showers are common during July and August. The park receives approximately 18 inches of precipitation each year. Almost half of the precipitation comes in the form of snow. The average snow fall varies between 80 to 100 inches per year.
The Mancos River is in a zone characterized by semi-arid, moderately high altitude, and pinyon-juniper forests. (us-parks.com).

## CHANNEL AND CONTROL:

Bed material at the gage varies from moderately deep silt in the slow moving water of the gage pool to embedded gravels and small cobbles in the swifter flows. The low and mid-flow control is the natural riffle approximately 80 feet downstream of the cantilever gage, just downstream of the gage pool. The control is composed of cobbles and boulders. It appears to be relatively stable and free from siltation effects. The control at higher flows is the channel. At very high stages (> 3.0'), water will enter a broad floodplain on the left bank. During winter months, the control is affected by ice (**Photo 2**).

The channel is straight for about 100 feet above the gage, where the flow exits from a sharp bend. At this point the bank is very steep, composed of moderately erodable silt and is being undercut. Below the gage, the channel is straight for about 100' and has moderately sloping banks anchored by moderately heavy stands of willows and grasses.

## GAGE:

The stage sensor is a Design Analysis – Waterlog H350XL/H355 (serial number S#001187) bubbler system installed on 11/07/2001 with a GOES transmitter that provides satellite telemetry data retrieval. This unit is considered the Data Collection Platform (DCP), but may also be referred to as the 'logger' or 'datalogger' (**Photo 3**). There is no backup recorder. The DCP is housed in a Hoffman steel enclosure mounted to 4 x 4 wood posts. A WaterLog H-222 satellite transmitter was added on 5/9/02. Transmitter information is:

- ID: FA4087CC
- Channel: 002 west
- Rate: 3 hrs
- Time offset: 00:25:00 (set to 00:25:08)
- Antenna direction: Azimuth from true north = 205 degrees, Azimuth from magnetic north = 220 degrees, latitude = 40 degrees.

Gage height data is logged at 15 minute intervals, and transmitted via GOES every 3 hours. The NPS-WRD has a cooperative agreement with the Cheyenne, WY district of the USGS to use their Local Readout Ground Station (LRGS) for data retrieval. The unit value data is automatically decoded and entered into Cheyenne's ADAPS database.

The original base gage was an enameled outside vertical staff (OVS) in two sections reading from 0.00 to 6.66' gage datum, mounted on adjustable planks and secured to steel rods (**Photos 5, 6**). A cantilever gage (**Photos 4, 5, and 6**) was installed on November 5, 2002 approximately 25 feet upstream from the lower OVS due to siltation problems plaguing the lower OVS.

## HISTORY:

The gage has remained at original location since establishment.

July 18, 2000 A Campbell Scientific CR-510 with a 15-minute logging interval was installed by NPS-WRB and park personnel.

July 20 to August 5, 2001 Fire burned a significant portion of upstream drainage area. Sediment loads increased significantly following fire, but rating remained relatively stable. Noticeably increased sediment loads/deposits noted during final weeks of 2002 WY.

November 7, 2001 The original Basic Data Recorder (BDR) was upgraded to a Design Analysis Waterlog H350/XL.

May 9, 2002 A GOES transmitter was added to the H350 and began transmitting on 5/9/02. This unit is now considered the Data Collection Platform (DCP), but may also be referred to as the 'logger' or 'datalogger.'

November 5, 2002 Cantilever gage installed to alleviate sedimentation problems plaguing lower outside vertical staff. Construction of channel constrictors occurred on the right side of the channel to concentrate flow over orifice. An attempt to increase flow velocities to keep orifice area sediment free.

November 20, 2002 Channel further constricted with placements of rocks on both sides of channel. Width at orifice decreased from 5 feet to 3.5-4 feet.

December 11, 2002 Orifice relocated upstream 25 feet to the cantilever gage location. Orifice moved to improve relationship between logger and outside gages. The cross sectional areas differed between the original orifice location and the cantilever's location. Software updated to resolve "bug" in program. Bubbler now purges automatically as programmed where previously it did not.

September 15 and 16, 2004 Orifice relocated back to gage pool (using original piping). Upstream orifice location was acting as a control during low flows. Lower OVS was relocated to LB where higher flows should alleviate the sedimentation problems. (**Photo 6**).

## REFERENCE AND BENCHMARKS:

A base and three reference marks have been established at the gage site for elevation control. See **Table 1** for elevations. See **Figure 2** for a sketch map and descriptions of gage site reference marks.

| Date | Ground rod (base) | RM-3 (US) | RM-1 (mid) | RM-2 (DS) |
|---|---|---|---|---|
| 07/11/01 | - | 6.47 | 6.18 | 6.07 |
| 11/08/01 | 6.57 | 6.47 | 6.19 | 6.08 |
| 05/09/02 | 6.57 | 6.47 | 6.18 | 6.06 |
| 09/19/02 | 6.58 | 6.47 | 6.18 | 6.07 |
| 11/05/02 | 6.87 | 6.47 | - | 6.07 |
| 11/20/02 | 6.57 | 6.47 | 6.19 | 6.08 |
| 04/16/03 | 6.57 | 6.48 | - | 6.08 |
| 10/08/03 | 6.57 | 6.47 | 6.18 | 6.07 |
| 05/18/04 | 6.57 | 6.48 | 6.20 | 6.07 |
| 09/15/04 | 6.57 | 6.47 | 6.18 | 6.07 |

**Table 1: Reference and Base Elevations**

## DISCHARGE MEASUREMENTS:

Wading measurements can be made in the vicinity of the gage up to a stage of about 2.20 feet. At higher stages, the private bridge approximately 2 miles upstream could be used for a bridge measurement by bridge crane or tethered ADCP.

## FLOODS:

Maximum peak flow since the gage was established occurred on September 9, 2003 at 1,060 cfs.

## POINT OF ZERO FLOW:

The point of zero flow is the deepest part of the channel at the control just downstream of the gage pool. The elevation of the PZF relative to gage height has varied between + 0.2 feet and – 0.2 feet.

## WINTER FLOW:

The stage-discharge relationship can be affected by ice cover during the winter months.

## REGULATION AND DIVERSION:

During Montana's standard irrigation season, April 15 through October 15, irrigation diversions influence summer stream discharge.

## ACCURACY:

During mid-flows, between 1.3' and 3.0', the accuracy of the gage site is good with the exception of winter months when the river is ice covered. The low and high flows need more measurements to better define the rating. Winter measurements are also needed to better estimate winter flows.

## COOPERATION:

Gage is maintained by LIBI staff and the Water Resources Division - Water Rights Branch of the NPS. LIBI staff visits the site to inspect logging equipment and collect discharge measurements. Winter visits are less frequent. WRB works up the record in ADAPS (USGS) and collects periodic Q measurements and provides QA/QC.

## LOCAL PARK PARTNER:

Park Staff Contacts:
Sylvia Oliva (970) 529-5065
Marilyn Colyer (970) 529-5064

Mesa Verde National Park
Natural Resources
P.O. Box 8
Mesa Verde, CO 81330

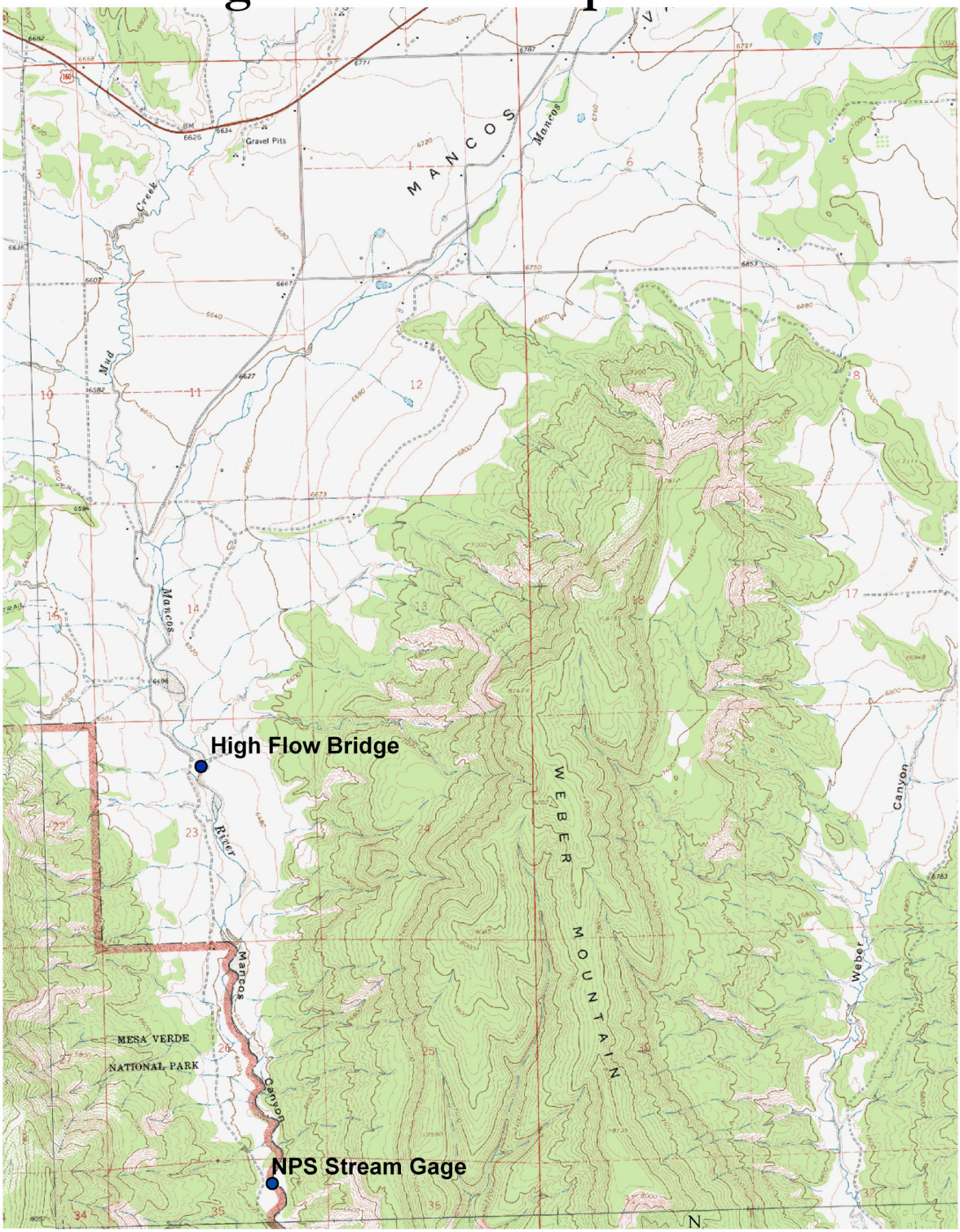
## REFERENCES:

"Mesa Verde National Park Climate" US-Parks.com. 2000-2004. US-Parks.com Inc. 21 June 2004 <http://www.us-parks.com/US_National_Parks/mesa_verde/mesa_verde_climate.shtml>.

"Mesa Verde National Park Geolgoy" US-Parks.com. 2000-2004. US-Parks.com Inc. 21 June 2004 <http://www.us-parks.com/US_National_Parks/mesa_verde/mesa_verde_geology.shtml>.

Skridulis Michael. "Mesa Verde National Park". 20 April 2004. Online. 21 June 2004 <http://oldsci.eiu.edu/geology/parks/meve/meve.html>

# Stream Gage Location Map




Produced by Water Resources Division - Water Rights Branch

August, 2004

**Figure 1: Gage Site Location Map**

United States
Department of the Interior
National Park Service
Water Resources Division

**GAGING STATION LEVELS SKETCH MAP**

Mancos River at Anitas Flat
Station # 371508108212801

| SURVEY LOCATION DESCRIPTIONS | |
|---|---|
| Ground Rod | base: top of DCP ground rod |
| RM-3 | reference mark 3: top of re-bar (farthest upstream) |
| RM-1 | reference mark 1: top of re-bar (mid) |
| RM-2 | reference mark 2: top of re-bar (farthest DS, next to DCP) |
| OVS-1 | nail at 2.0 ft on low flow vertical staff plate |
| OVS-2 | nail at 5.2 ft on high flow vertical staff plate |
| OHS | upstream bolt (with 'X' mark) on cantilever T flange |
| Orifice Cap | before ridge on orifice cap (see sketch below) |
| PZF | point of zero flow on control directly downstream of pool |

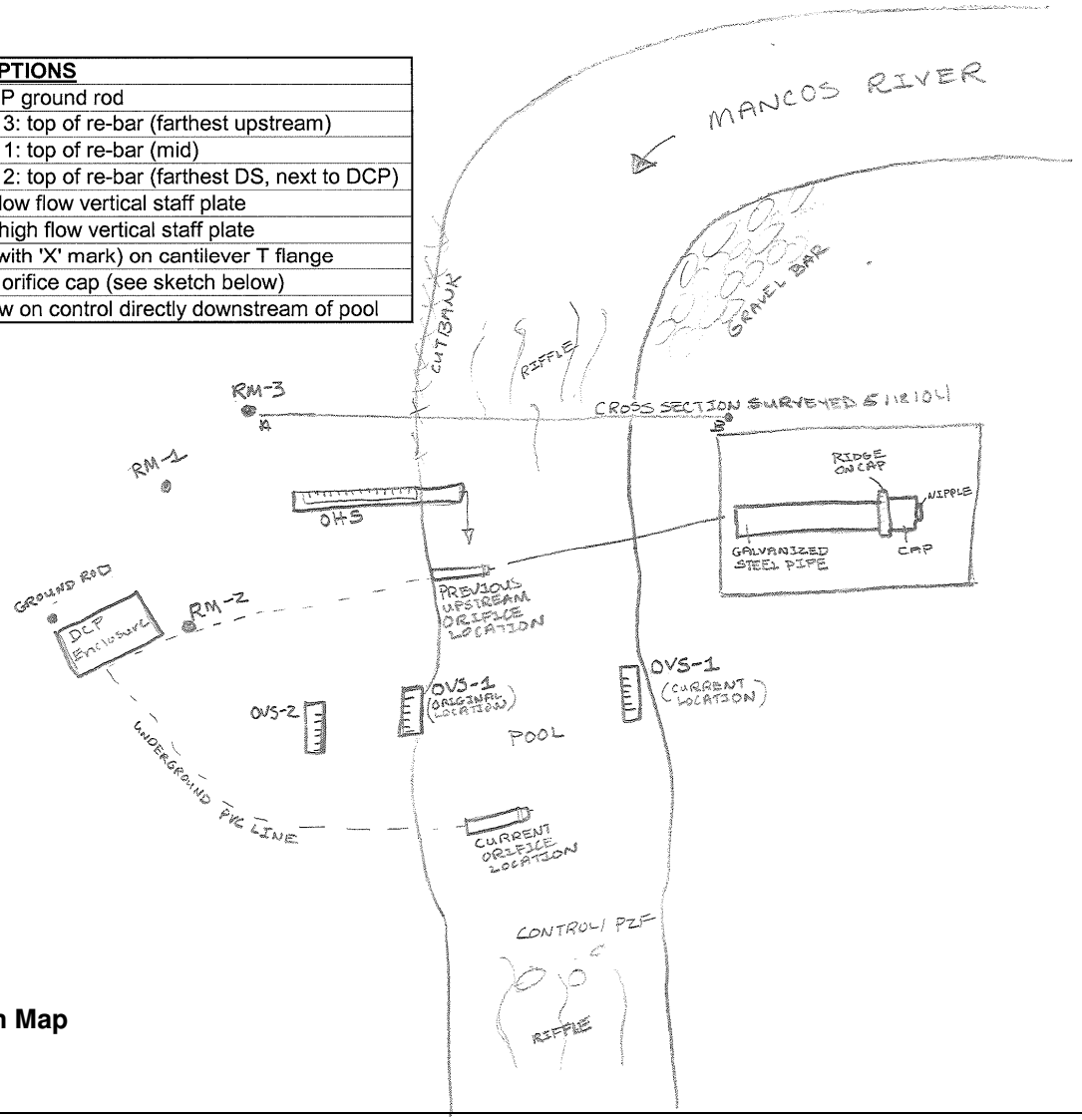



**Figure 2: Gage Site Sketch Map**

**Photo 1: Possible High Flow Measurement Location (from 5/18/04 site visit)**

**Photo 2: Winter Ice Conditions (from 12/01/04 site visit)**

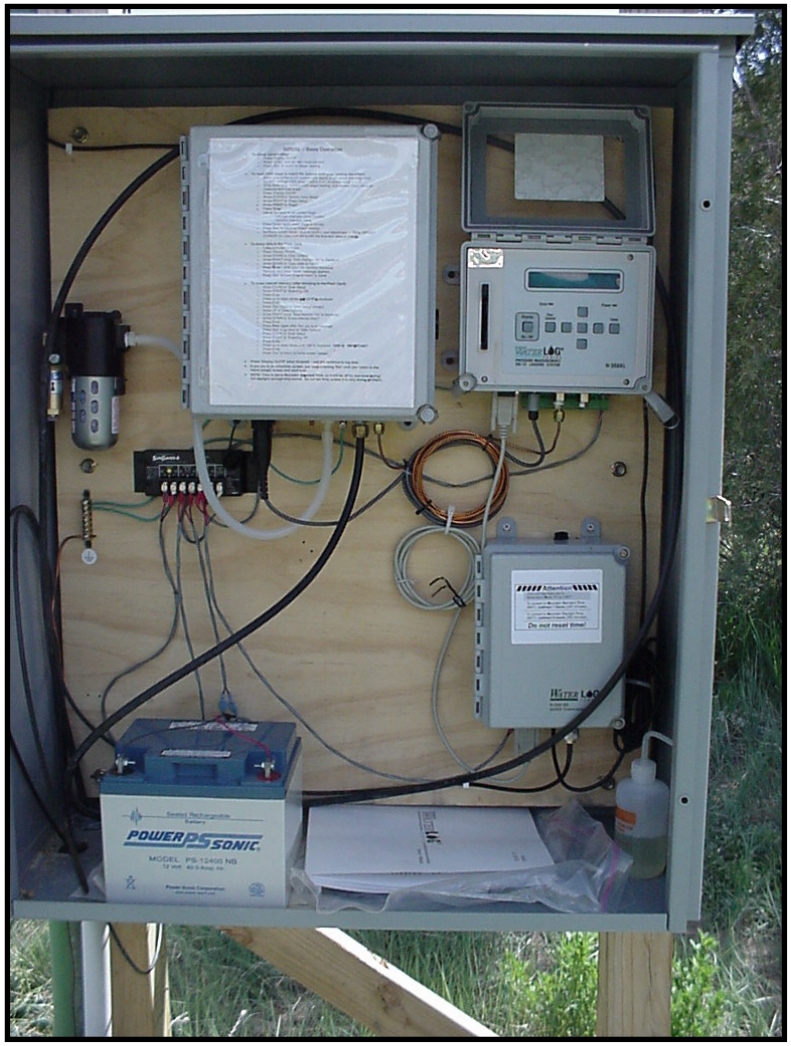



**Photo 3: Water Log H350XL/H355 (from 5/18/04 site visit)**

**Photo 4: Cantilever Gage (from 11/20/02 site visit)**

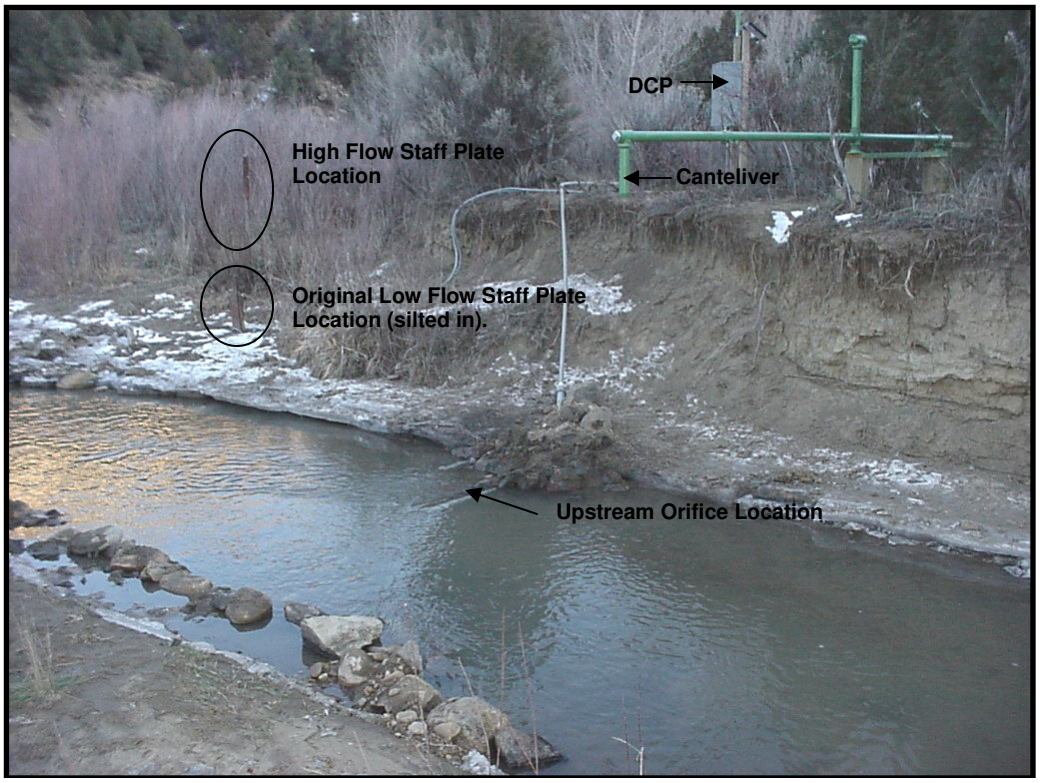



**Photo 5: Gage Site Schematic – looking at RB (from 12/11/2002 site visit)**

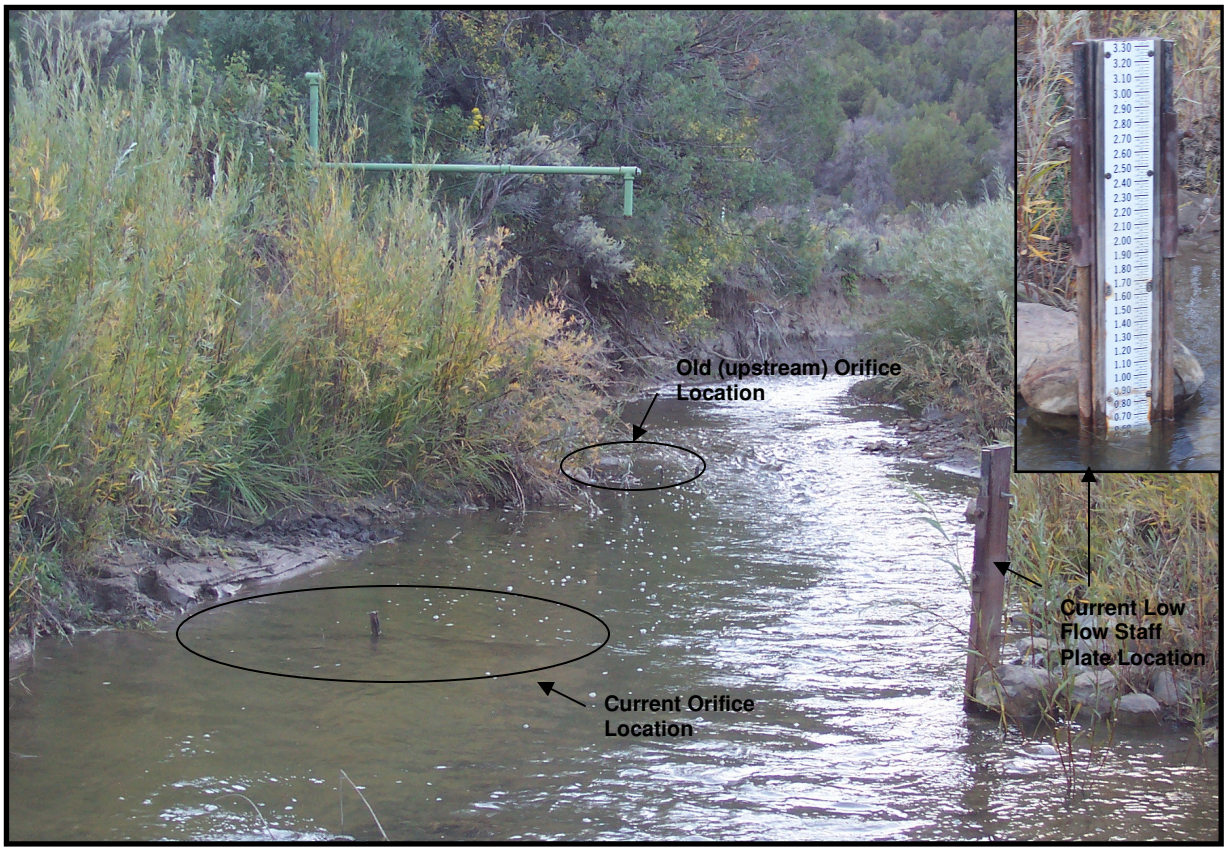



**Photo 6: Gage Site Schematic – looking US (from 09/16/2004 site visit)**